

Myocardial Revascularization in Patients 70 Years of Age and Older

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Myocardial revascularization has been carried out by us in 67 patients 70 years of age or older. Advanced coronary artery disease was found at angiography in more than two thirds of the patients. The postoperative morbidity and mortality compare very favorably with those in younger patients. The early and late mortality in the 67 patients was 4.5 percent and 6.0 percent, respectively. Fifty-seven survivors have been followed an average of 21 months; for most patients there has been a pronounced improvement in clinical classification. Properly selected, patients of advanced age can undergo successful revascularization surgical procedures. The adequacy of function of the left ventricle, proper timing of the surgical operation and an aggressive yet realistic approach seem to be major determinants for a good result.

MYOCARDIAL REVASCULARIZATION using the reversed autogenous saphenous vein technique has become an established form of treatment for symptomatic ischemic coronary artery disease. As experience increases, the indications for this surgical procedure are becoming more refined while, at the same time, the operation is being extended to others, particularly older patients. This is due in part to the increasing safety of the procedure as surgical teams become more experienced in the techniques of revascularization, including myocardial protection during the bypass procedure, as well as the excellent preoperative and postoperative care given these patients in coronary care and cardiac surgical units.

Of particular interest to us has been revascu-

larization operations in older patients. In 1973 we reported experience with 100 patients aged 65 years and older in whom surgical operation was carried out for coronary artery disease and its complications.¹ Others also have reported that cardiac surgical procedures, including revascularization, can be done in older patients with acceptable morbidity and mortality, and excellent long-term results. The basis for this report is an analysis of 67 patients 70 years of age or older, who underwent myocardial revascularization for coronary artery disease. These patients represent a very select group, inasmuch as no patient is included who had myocardial resection or valve replacement for complications of coronary artery disease. This group affords a valid comparison to patients of a younger age, since the most widely performed operation for coronary artery disease is myocardial revascularization alone.

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MYOCARDIAL REVASCULARIZATION

Clinical Data

From June 1969 to October 1975 myocardial revascularization alone was carried out in 1,886 patients for coronary artery occlusive disease. Of these, 67 (3.6 percent) were 70 years of age or older. The ages ranged from 70 to 81, with an average of 72.4 years. There were 51 men and 16 women. In more than two thirds (67 percent) of the patients angina occurred at rest or was of recent onset, factors believed to be associated with severe coronary artery disease. In 21 patients there was a history of antecedent myocardial infarction. In eight patients there was a history of heart failure, a bad prognostic sign in coronary artery disease. In four patients there were severe, life-threatening arrhythmias, and in two these were the only indication for surgical operation (Table 1). Two patients were referred for operation after a diagnosis of ischemic coronary artery disease was made during evaluation for surgical treatment of abdominal aneurysm. In one severe claudication of the lower extremities was present. No patient in this group had a history of hypertension or diabetes. Two were considered in Class II, 48 in Class III, and 17 in Class IV (New York Heart Association classification).

In all coronary cineangiography and ventriculography were done before operation. The cineangiography showed the presence of advanced coronary artery disease in 77 percent of the patients. In these patients either triple vessel disease or significant left main coronary artery obstruction, often of a very high degree, was present together with right coronary artery obstruction. In the remainder there was either proximal left anterior descending lesions or two vessel disease. Ventricular performance was interpreted as normal in 30 patients. Segmental dysfunction was present in 29 patients and in 8 the ventricle was generally hypocontractile (Table 2).

Method

There were no emergency operations. Patients with unstable anginal symptoms or life-threatening lesions (especially left main coronary artery obstructions), or both, were operated on an urgent basis.

Our surgical technique has been modified since our 1973 report, essentially to provide better myocardial protection during the revascularization. All operations are carried out using cardio-

TABLE 1.—Cardiac Findings in 67 Patients

Angina	
At rest	45
With exercise	10
Of recent onset	6
Previous myocardial infarction	21
Heart failure	8
Arrhythmia, severe	4

TABLE 2.—Angiographic Findings in 67 Patients

Extent of Disease	Number of Patients	Ventricular Function		
		Normal	Fair	Poor
Single vessel (LAD)	7	6	1	..
Two vessel	8	6	2	..
Three vessel*	52	18	26	8

*Includes 22 with left main coronary artery disease.

TABLE 3.—Postoperative Complications in 23 Patients

Arrhythmia	13
Postoperative bleeding requiring reoperation	4
Respiratory insufficiency	4
Congestive heart failure	2
Myocardial infarction	1
Renal failure	1
Thrombophlebitis	1
Pulmonary embolism	1
Wound infection	1

pulmonary bypass with a disposable bubble oxygenator and hemodilution. The ascending aorta is cannulated routinely and a single right atrial cannula is used. The left ventricle is always vented through the right superior pulmonary vein. Moderate core cooling to 28°C is achieved. In addition, local cooling of the heart with topically administered saline at 4°C is used to protect the myocardium during the periods of ischemic cardioplegia. The distal anastomoses are done with a quiet heart by intermittent cross clamping of the aorta; the individual cross-clamp times are of approximately 15 minutes' duration. The aortic anastomoses usually are done after the completion of each distal anastomosis, employing partial side-biting of the aorta to permit resumption of myocardial blood flow and thus repay the myocardial oxygen debt. While separate grafts are used most commonly, sequential grafts are done with increasing frequency in an attempt to revascularize more vessels and to enhance the flow in the grafts by providing more runoff. This is in keeping with the concept of total revascularization. All anastomoses are carried out using interrupted suture of 6-0 and 7-0 synthetic material.

MYOCARDIAL REVASCULARIZATION

TABLE 4.—Cause of Death in Seven Patients

<i>Early</i>	
Left ventricular failure	3
Intraoperative	1
Early postoperative	2
	<hr/> 3 (4.5%)
<i>Late</i>	
Heart failure	1
Sudden death	1
CVA	1
Unknown	1
	<hr/> 4 (6.0%)

The average cardiopulmonary bypass time rarely exceeds 90 minutes for complete revascularization. A total of 154 saphenous vein bypass grafts were done in the 67 patients, an average of 2.3 grafts per patient. Four internal mammary-coronary artery anastomoses were carried out.

Results

Postoperative nonfatal complications occurred in 23 patients (Table 3). The most frequent complication was minor arrhythmia. In four patients re-exploration was required for excessive bleeding early in the postoperative course. Respiratory insufficiency requiring ventilatory support for a period not exceeding 48 hours was present in four patients; no tracheostomies were required.

Three patients died in the early postoperative period, a mortality of 4.5 percent (Table 4). All these deaths were due to left ventricular failure. Early in our experience, a patient with left main coronary artery disease and a normal ventricle could not be taken off bypass after having three grafts. Normothermic perfusion was used and no form of myocardial protection offered. Two patients with severe diffuse three-vessel disease, generally hypocontractile ventricles and a history of failure constitute the other early postoperative deaths. In one of these patients extensive right coronary artery endarterectomy was required because of diffuse disease in addition to saphenous vein bypass grafting. The patient died from left ventricular failure on the first postoperative day. An extensive recent thrombus, extending up to the distal point of the endarterectomy, and a recent infarct were noted. The other early death was also due to left ventricular failure.

There have been four late deaths; two patients died as a consequence of their disease, assuming that the patient in whom sudden death occurred died of an arrhythmia (Table 4). Both these pa-

tients had triple vessel disease; one patient received three grafts, the other four. One other patient succumbed to a cerebrovascular accident, and the cause of death in the fourth patient remains unknown. These four late deaths represent a late mortality of 6 percent, and a cumulative mortality of 10 percent for the entire group.

Continued yearly follow-up of 57 of the survivors is being carried out. They have been followed for a period varying from three months to 54 months, with an average of 21 months. The data on three others remain inconclusive and hence are not included. There have been three late myocardial infarctions in three patients; in another patient a subdural hematoma developed in an auto collision while on a regimen of anticoagulants. All four patients survived. In one patient with an abdominal aneurysm an operation has been successful, while the other person with a similar aneurysm awaits operation. Aortoiliac reconstruction has been carried out in a woman with severe lower extremity claudication and the patient has made an uneventful recovery. All patients improved with the exception of two in Class II and two in Class III (Figure 1). The two patients in Class II were operated upon in anticipation of later operation for abdominal aneurysms. Their cardiac symptoms remain unchanged. In two patients in Class III there was preoperative impairment of left ventricular function; both continue to be moderately incapacitated. Most of the patients were very grateful and thought the operation worthwhile, permitting as it did most of them to resume normal activity.

Eight patients have been restudied, and 15 of

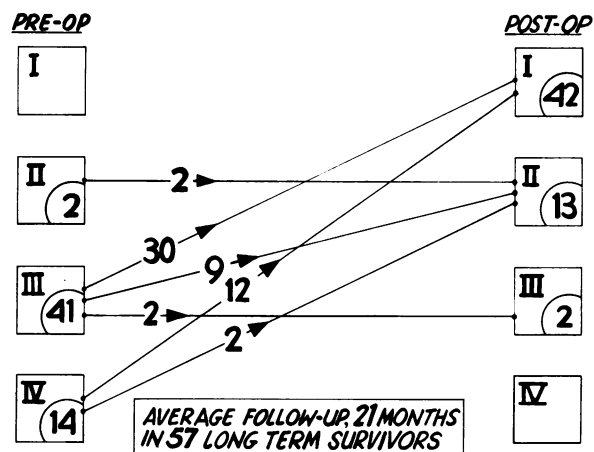


Figure 1.—Clinical classification (New York Heart Association) of 57 long-term survivors. See text for explanation.

16 bypass grafts are patent. Restudy was done because of recurrent angina in two patients, and as part of a routine late postoperative evaluation in the others.

Discussion

Cardiac surgical procedures in the elderly, though associated with an increased risk, can be carried out with an acceptable morbidity and mortality.¹⁻⁴

Our experience, reported here, with patients 70 years of age and older who have symptomatic coronary artery disease shows that these patients can be expected to do as well as younger patients, provided rigid indications for operation are maintained. The 27 complications occurring in the 23 patients makes a complication rate of 33 percent. In our group of patients less than 70 years of age, the complication rate is 27 percent, somewhat lower. The nature of the complications is the same in both groups. Of note, however, is an incidence of 1.5 percent cerebrovascular accident and 0.82 percent of sternal dehiscence in the younger group. Neither of these problems occurred in the patients older than 70. Postoperative inotropic support in this small group was unusual. Most of these patients have been operated upon since 1973, when we began using core cooling and topical cooling of the heart. This form of myocardial protection enhances, we believe, postoperative left ventricular function and decreases the need for such inotropic support.⁵ The incidence of early postoperative myocardial infarction is 1.4 percent in both groups.

The early postoperative deaths in this series were attributable to factors that could have been altered. The one patient with left main coronary artery disease and a normal ventricle was operated upon early in our experience. No type of myocardial protection was carried out and the deterioration in ventricular function, which prevented removing the patient from cardiopulmonary bypass, was probably avoidable. The two patients with severe left ventricular dysfunction probably should not have been operated upon. These two deaths cannot be ascribed to advanced age, since three vessel coronary artery disease with a generally hypocontractile ventricle causes a similarly high surgical risk regardless of a patient's age.⁶ Comparison of the early and late mortality in the 67 patients with those of the patients under 70 years (1,819 patients) is given in Table 5.

TABLE 5.—Comparison of Early and Late Mortality

	<i>Patients Under 70</i>	<i>Patients 70 and Over</i>
Number of patients	1,819	67
Early deaths	3.1%	4.5%
Late deaths	4.6%	6.0%
Mortality rate	7.6%	10.0%

The very large proportion of severely symptomatic patients in this group, together with the findings of severe three vessel disease and a large number of left main coronary artery lesions, shows that in these elderly people surgical operation is needed to protect against a possible catastrophe. The lethal potential of significant left main coronary artery obstructions is well recognized.⁷ For less symptomatic elderly patients, and there were few in this series, the quality of life desired by each patient should be a consideration when advising about surgical operation. To deny surgical treatment to a patient because of advanced age alone does not seem warranted based on these results. Medical treatment only should be reserved for elderly patients who have other system disease that militates against a major operation and for patients whose symptoms are such that they can be easily controlled.

From the standpoint of technique, there is no doubt that the proficiency of the surgical team shortens the operating time and decreases the period of myocardial ischemia while permitting maximal revascularization in the shortest operative time. Protection afforded the myocardium by core cooling and local cooling of the heart seems to decrease the injury incident to ischemic arrest. The proficiency of the anesthesiologists and of coronary care and cardiac surgical units helps in the common goal to minimize complications and improve survival.

The adequacy of revascularization by adhering to the concept of total revascularization is important.⁸ Our experience with long-term follow-up of 929 patients in whom revascularization was done for triple vessel coronary artery disease shows that when complete revascularization is carried out the yearly death rate is 2.3 percent. This increases to 3.5 percent if only two vessels are revascularized and 7.7 percent if only one graft is placed.⁹ The small number of patients in this study does not make a comparison possible, but it seems that this concept applies to all ages. In this group of patients the average number of grafts per patient was 2.3. In our first 1,650

MYOCARDIAL REVASCULARIZATION

myocardial revascularizations, the average number of grafts per patient also was 2.3. This implies that in older patients properly selected for revascularization there are an equal number of vessels suitable for bypass grafting as in younger patients.

There is no ideal age for myocardial revascularization. One must rely largely on the symptomatology, realizing that some characteristics of ischemic coronary artery disease, such as unstable angina or angina at rest, frequently are associated with severe coronary artery disease. In other cases, however, the degree of coronary occlusive disease found at the time of angiography will belie the clinical features. Certainly, in anticipation of a good result, all patients including older ones should be operated upon before myocardial damage becomes irreversible.

We believe another factor that has an adverse effect on the outcome is the urgency of the operation. We feel that early elective surgical operation should be done in patients with triple vessel disease or left main stem occlusion because of the increased risk of sudden death or myocardial infarction compared with that in patients with lesser extent of disease. The reluctance on the part of physicians and surgeons to consider surgical intervention in the elderly may jeopardize an otherwise excellent chance to obtain a good

result. Urgent cases can become catastrophic emergencies if a rule of procrastination is allowed to prevail. This report deals with a select group of elderly patients. Proper case selection seems the main requisite to assure a good result keeping in mind, as in all age groups, that the main determinant of risk in coronary revascularization is the adequacy of the function of the left ventricle. By adopting a realistic, yet aggressive approach, patients of advanced age requiring myocardial revascularization can expect a result that is comparable with that in younger patients.

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